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Microbiologic Activity in Laser Resurfacing Plume and Debris

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Background and Objective: **With the increasing use of laser resurfacing, concerns have arisen about the biological hazards associated with the procedure. This study analyzed the potential bacterial and viral exposure to operating room personnel as a result of the laser smoke plume in CO_2 laser resurfacing.**
Study Design/Materials and Methods: **Thirteen consecutive patients underwent CO_2 laser resurfacing. A HEPA filter in the smoke evacuator was used to collect specimens of the laser plume smoke for cultures. The study was controlled by a second filter exposed to room air.**
Results: **The 13 patients each had one bacterial, one viral, and one control culture (total, 39 specimens). In the control group, none of the 13 specimens had any growth. No viral growth has been found to date. Of 13 bacterial cultures, 5 resulted in growth of coagulase-negative *Staphylococcus*. Of these five positive specimens, one also had growth of *Corynebacterium* and one had growth of *Neisseria*.**
Conclusion: **The potential exists for operating personnel to be exposed to viable bacteria during laser resurfacing. Lasers Surg. Med. 23:172–174, 1998.** **© 1998 Wiley-Liss, Inc.**

Key words: airborne infection; laser smoke; smoke evacuation

INTRODUCTION

With the performance of CO_2 laser resurfacing in venues such as television studios, concerns have arisen in the plastic surgical community about appropriate safety precautions being taken. The literature supports the presence of viable tumor cells [1] and intact viral DNA and proviral human immunodeficiency virus (HIV)-DNA within the laser plume [2] during laser ablation procedures utilizing continuous-wave lasers. Furthermore, inspired laser vapor by-products have been demonstrated to cause anatomically identifiable lesions in animals [3].

The popularity of laser resurfacing is now reaching its zenith in the midst of continuing codification by the Centers for Disease Control with regard to exposure to blood-borne pathogens. The lack of information regarding the exposure of medical personnel during laser ablation prompted us to study whether viable bacteria and viruses may expose the patient or personnel to biological hazards from the laser plume [4,5].

MATERIALS AND METHODS

In this prospective study, 13 consecutive patients were enrolled. All patients underwent laser resurfacing for aesthetic reasons. Laser resurfacing was done in the periorbital, perioral, or full-face regions with the Tru-Pulse laser (Tissue Technologies, Albuquerque, NM). This is a high-energy, short-pulse-duration CO_2 laser. Energy delivery was set at 500 mJ/cm^2.

A smoke evacuator (Stackhouse Point One System, El Segundo, CA) was used with a Millipore HEPA filter (New Bedford, MA). Before laser

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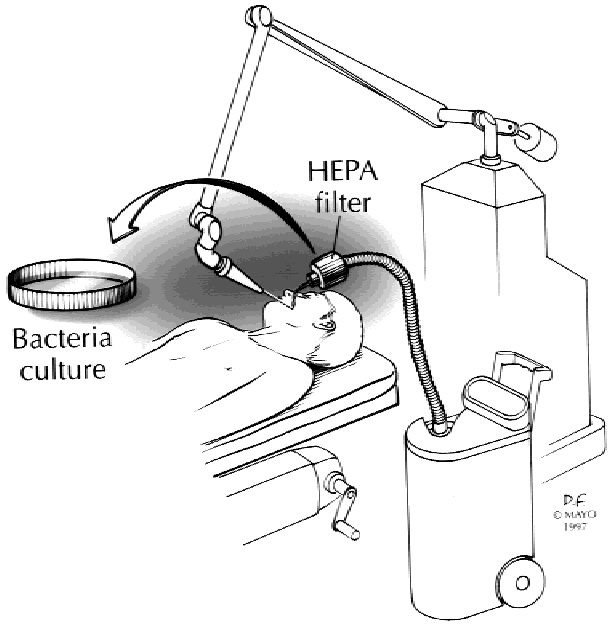

Fig. 1. Laser plume evacuator and culture technique (by permission of Mayo Foundation).

resurfacing, room air was filtered with the smoke evacuator, and this filter was utilized as the control (Fig. 1). The patient was then brought into the room, and at the time of laser resurfacing two consecutive filters were used to evacuate laser smoke for a total of 5 minutes for each filter. Two bacterial and two viral cultures were obtained per filter. Bacterial cultures were incubated for 14 days if results were negative, and viral cultures were incubated for 28 days if results were negative.

RESULTS

Thirteen consecutive patients were enrolled in our study, and three cultures were done for each patient: one control and two during exposure to laser smoke. Twelve of the patients were female and one was male. Six patients underwent full-face laser resurfacing, five had periorbital, one had perioral, and one had both perioral and periorbital treatments.

No growth occurred from any viral specimen (Table 1). Five patients had a culture that grew +1 coagulase-negative *Staphylococcus.* Two of these five patients had a concomitant bacterial growth of either *Corynebacterium* or *Neisseria.* There were no complications from the collection system, and no patient sustained any surgical complications.

DISCUSSION

Transport of biologically viable material in high-powered pulsed CO_2 and erbium YAG (yttrium-aluminum-garnet) lasers has been demonstrated in animals. Furthermore, Frenz et al. [6] have shown that the transport of hot water vapor derived from a cutting laser can carry bacteria from the surface to below the skin level in an injured area. Also, inhalation of the fine particulate matter from the laser plume can cause pneumonia and bronchiolitis in animals [3]. No prospective studies illustrate the presence of viable bacteria during use of a pulsed CO_2 laser.

In our study, coagulase-negative *Staphylococcus* was grown in cultures of 5 of the 13 patients. Two patients had a secondary bacterium, either *Corynebacterium* or *Neisseria.* We must thus conclude that biologically active material does exist in the laser resurfacing smoke plume.

Our results corroborate the findings of others. Hoye et al. [1] demonstrated viable tumor cells within a laser plume. Despite temperatures as high as 400°C generated by the laser, Baggish et al. [2] reported that the HIV proviral DNA is present in laser smoke.

Our study used a HEPA filter with a pore size of 0.22 μm. Although no virus was cultured in this study, it cannot be concluded that viable viruses are not present in the smoke plume because this pore size would be large enough to allow passage of viruses.

Currently, there are no defined exposure levels with regard to laser smoke. The lack of literature illustrating the finding of biological material within laser smoke is consistent with the paucity of standards governing exposure to laser plume and debris. During treatment of high-risk patients, such as those colonized with methicillin-resistant *Staphylococcus aureus,* the entire operative team could be exposed.

This study emphasizes the paramount importance of using a laser smoke evacuation and filtration system during laser resurfacing [5]. In addition, the tissue debris produced by laser resurfacing should be managed according to universal precautions for blood-borne material until more is known regarding the risk of spread of bacterial and active viral particles.

CONCLUSIONS

Viable bacteria exist within the laser smoke plume during laser resurfacing. Further prospec-

TABLE 1. Laser Debris in Patients Who Had Laser Resurfacing[a]

			Patient	
Case	Area	Control	Bacterial	Viral
1	Full face	No growth	No growth	No growth
2	Full face	No growth	No growth	No growth
3	Full face	No growth	No growth	No growth
4	Orbit	No growth	Coag-*Staph*[b]	No growth
5	Orbit	No growth	Coag-*Staph, Corynebacterium*	No growth
6	Oral	No growth	Coag-*Staph, Neisseria*	No growth
7	Full face	No growth	No growth	No growth
8	Orbit	No growth	Coag-*Staph*	No growth
9	Orbit	No growth	No growth	No growth
10	Full face	No growth	No growth	No growth
11	Full face	No growth	No growth	No growth
12	Orbit	No growth	No growth	No growth
13	Full face	No growth	Coag-*Staph*	No growth

[a]Energy delivery was 500 mJ/cm^2 in each case.
[b]Coag-*Staph,* coagulase-negative *Staphylococcus.*

tive studies will need to be done to better illustrate the exposure risk associated with high-risk patients and blood-borne pathogens such as hepatitis, HIV, and antibiotic-resistant bacteria.

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